Ophthalmic diagnostic apparatus for different types of tests

The invention relates to ophthalmological diagnostic apparatus.

It relates more particularly to apparatus for effecting tests on a patient for identifying defects of vision such as ametropia, phoria and dyschromatopsia and for effecting measurements such as measurement of the visual acuity of the patient.

This type of apparatus is intended to display various tests adapted to the defects to be detected. The patient is asked what he sees as the tests proceed and the diagnostic is effected as a function of his response.

Thus certain tests are colored (for example tests designed to detect a fusion or color vision defect), others represent large patterns (for example the "Parent dial" for testing astigmatism or measuring phoria), and others in contrast represent very small patterns that must be produced with great accuracy (Landolt rings or other optotypes for high acuity). These tests also vary from country to country.

There is therefore a very large number of these tests which differ in color, size and display accuracy, to the point where it is difficult to produce apparatus adapted to display a large number of different tests with very different characteristics.

In fact, tests based on optotypes of small size, for example conforming to ISO standard 8596, necessitate a high display accuracy whereas other tests, for example astigmatism tests, require the display of large images or color images, without necessitating any particular display accuracy.

On a graphics screen, display accuracy is achieved by a small pixel size, in other words by a high

resolution per unit area.

There is no commercially available screen having a resolution able to display both tests necessitating accuracy and tests that display large patterns. There are nevertheless various possibilities for displaying different ophthalmological tests. Certain apparatus uses a screenprinted strip on which all the tests are printed, for example. A portion of the strip is displayed in an active window and a mechanical system moves the strip to display the required test in front of the active window.

The above system is a mechanical system for generating virtually all the screening tests and is designed to enable the screenprinted strip to be changed to adapt it to other countries or uses.

Other, similar apparatus uses tests printed on a drum or turntable, rotation of the drum or turntable presenting the test that it is wished to display in an active window.

Other apparatus uses graphics screens, for example of the cathode ray tube (CRT) type or the liquid crystal display (LCD) type. These screens provide very many tests on a single surface without necessitating any mechanical movement. There are therefore many screening software packages for displaying tests on conventional computer screens. The tests are also very easy to modify or to adapt according to the country, as they necessitate only a software modification. The drawback of these systems is that the resolution of the screens is insufficient to obtain both an image of reasonable size and pixels small enough to produce small optotypes with the required accuracy, for example the accuracy required by the ISO standard cited above.

Moreover, other apparatus is limited to displaying predefined patterns on the screen but can display small optotypes very accurately.

An object of the invention is to use a configurable graphics display to improve the above type of apparatus to enable the display of tests comprising both large patterns and small optotypes.

To this end, the invention is directed to ophthalmic diagnostic apparatus characterized in that it includes a first body to be viewed from a predetermined position and a second body to be viewed from said position, each body being adapted to display ophthalmic test patterns, the second body to be viewed being disposed between the first body to be viewed and the predetermined position, which first body to be viewed has a uniform state and a state for showing signs and which second body to be viewed has a transparent state and a state for showing signs, and in that it further includes a control module for the first and second bodies to be viewed adapted to cause them to assume a first configuration in which the second body to be viewed is in its state for showing signs and the first body to be viewed is in its uniform state and a second configuration in which the second body to be viewed is in its transparent state and the first body to be viewed is in its state for showing signs.

The combination of the first body to be viewed, which is adapted to display large patterns, and the second body to be viewed, which is adapted to display small optotypes, gives the apparatus a dual function.

The two possible states of each of the bodies to be viewed are managed by the control module so that the required configuration may be selected as a function of the type of test.

Thus the different types of tests may be easily and quickly effected within the same apparatus. The specialization of each body to be viewed also means that the bodies can be optimized for their respective

application and produced at lower cost.

In a preferred embodiment of the invention, the apparatus may further have the features listed hereinafter, separately or in combination:

- the first body to be viewed includes a first graphics screen;
- the second body to be viewed includes a second graphics screen;
- one of the bodies to be viewed has a higher resolution per unit area than the other body to be viewed;
- the body to be viewed having the higher resolution is disposed between the other body to be viewed and said position;
- the first graphics screen and the second graphics screen are substantially parallel;
- the first graphics screen and the second graphics screen are superposed;
- the first graphics screen is a color screen and the second graphics screen is a liquid crystal display;
- the second graphics screen includes a liquid crystal display etched with predefined ophthalmic test patterns;
- the second body to be viewed includes a second graphics screen and a reflecting body adapted to reflect the second graphics screen;
- a first graphics screen belonging to the first body to be viewed is perpendicular to the second graphics screen belonging to the second body to be viewed and the reflecting body includes a semitransparent sheet disposed obliquely to the two graphics screens; and
- the second graphics screen has a smaller area than the first graphics screen.

Other features and advantages of the invention

will emerge in the light of the following description of a nonlimiting preferred embodiment of the invention, which description is given with reference to the appended drawings, in which:

- figure 1 is a diagram representing from the side the eye of a patient viewing a first embodiment of diagnostic apparatus of the invention;
- figure 2 represents the image viewed by the patient in figure 1;
- figure 3 is a view similar to figure 1 representing a second embodiment of diagnostic apparatus of the invention; and
- figure 4 is a view similar to figure 2 representing the second embodiment of diagnostic apparatus of the invention.

Figure 1 represents diagrammatically the main components of ophthalmic diagnostic apparatus. A control module 1 is connected to a first graphics screen 2 and to a second graphics screen 3. In this first embodiment, the graphics screens 2, 3 are superposed to form a display adapted to display many types of tests, including tests in color, and to display tests requiring high accuracy, without mechanical movement.

The first graphics screen 2 is a color graphics screen of the LCD, CRT or equivalent type, of moderate resolution, for example 800 rows by 600 columns in the case of a 15" screen. This screen is used to display tests necessitating colors, such as phoria tests, fusion tests, duochrome tests, Hishiara tests. It is also used to display other types of tests, for example tracking tests, acuity tests (for relatively low acuity) and astigmatism tests.

These various tests have the common feature of not necessitating a high display resolution. The graphics screen 2 may therefore consist of an ordinary computer

display of relatively low cost.

The second graphics screen 3 is used to display tests requiring high accuracy, which is not possible on the first graphics screen 2, for example acuity tests for high acuities.

In this configuration, the second graphics screen 3 is a transmission type liquid crystal display screen the same size as the first graphics screen 2. Patterns 9 corresponding to high acuity optotypes are etched directly onto the liquid crystal display screen during manufacture. Thus they do not consist of pixels and appear when a region of the liquid display screen having a predetermined shape is activated. Each optotype may be lit independently of the others.

When the liquid crystals of the second graphics screen 3 are not excited, the screen 3 remains transparent.

The control module 1, consisting of a computer and appropriate software, for example, provides a first function of display as such. It is used to display on the first screen 2 certain tests selected by the user and is also used to display on this first screen 2 a uniform surface, for example a white background.

The control module 1 is adapted to activate and deactivate each of the liquid crystal cells constituting the second screen 3 to cause certain of the optotypes etched therein to appear or to render this second screen 3 completely transparent by deactivating all the cells.

The control module 1 also has a second function of coordinating the displays on the first screen 2 and the second screen 3. The control module 1 is in fact adapted to offer a first display configuration in which the first screen 2 is commanded to display test patterns, the second screen 3 remaining transparent, and a second display configuration in which the first screen 2 is

commanded to display a uniform white image and the second screen 3 displays etched optotypes.

In the first display configuration, the eye 4 of a patient viewing the diagnostic apparatus sees only the tests displayed by the first screen 2.

In the second display configuration, the tests displayed by the second screen 3 appear by virtue of their contrast with the background that the first screen 2 constitutes. The latter is preferably lit when it is in its uniform state, as here. What the eye 4 sees in this configuration is represented in figure 2, which shows the two superposed screens 2, 3, the cross-hatching of the first screen 2 showing that the latter is in its "white screen" configuration whereas on the second screen 3 optotypes (here broken circles 9) appear in the foreground relative to the white background.

Figures 3 and 4 correspond to a second embodiment of the invention.

The ophthalmic diagnostic apparatus also includes a control module 5 connected to a first graphics screen 6 and to a second graphics screen 7. The graphics screens 6, 7 are disposed perpendicularly to each other and a semi-transparent sheet 8 is inserted obliquely between the two screens 6, 7 at an angle of approximately 45° to each of the screens 6, 7.

The first graphics screen 6 is similar to the first graphics screen 2 of the first embodiment shown in figures 1 and 2. The second graphics screen 7 is a screen of substantially the same resolution as the first screen 6 but of much smaller size, so that the second screen 7 has a resolution per unit area higher than that of the first screen 6 (i.e. the minimum size of a pixel of the second screen 7 is less than the minimum size of a pixel of the first screen 6).

Here the control module 5 is also adapted to

assume a first configuration in which the first screen 6 is activated and displays test patterns and the second screen 7 is turned off. The semitransparent sheet 8, which has the properties of an unsilvered mirror, allows the eye 4 of the patient to see the first screen 6 but does not reflect an image of the second screen 7 that is turned off.

In a second configuration of the control module 5, in which the eye 4 of the patient sees the image represented in figure 4, the first screen 6 is turned off and the second screen 7 is activated to display optotypes 9. Because of the semitransparent sheet 8, the eye 4 perceives only the patterns on the second screen 7 reflected from the surface of the sheet 8. An alternative in this second configuration is for the first screen 6 also to be lit. In this case, only the portion of the screen 6 on which the reflected image of the screen 7 is not superposed must be lit.

The ophthalmic diagnostic apparatus of which first and second embodiments have now been described is used in the manner indicated hereinafter.

The apparatus includes a first graphics screen 2, 6 produced at lower cost and the characteristics whereof (resolution per unit area) are adapted to display a large number of ophthalmic test patterns selected by the user by means of a software interface.

The second graphics screen 3, 7 is adapted to display tests that have to be produced with great accuracy.

The two screens 2, 3, 6, 7 are physically or optically superposed and are coordinated by a control module 1, 5 that renders one of the screens active while the other remains inactive. The user can select directly which configuration of the control module 1, 5 is the most suitable. The control module 1, 5 can moreover

select automatically the configuration appropriate to the test selected by the user.